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# FRAMES AS A FACTOR IN TRUCK GROWING.

BY

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## LETTER OF TRANSMITTAL

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
OFFICE OF THE CHIEF,  
*Washington, D. C., May 26, 1911.*

SIR: I have the honor to transmit herewith a manuscript entitled "Frames as a Factor in Truck Growing," by Mr. W. R. Beattie, Assistant Horticulturist, and recommend that it be published as a Farmers' Bulletin.

Respectfully,

WM. A. TAYLOR,  
*Acting Chief of Bureau.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*



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# FRAMES AS A FACTOR IN TRUCK GROWING.

## INTRODUCTION.

Intensive gardening under sash or cloth covers has become one of the most popular and, in certain localities where the conditions are suitable, one of the most profitable lines of outdoor work. The trucker and the market gardener of the present day have been compelled by keen competition and a constantly increasing demand for high-grade products out of season to provide special facilities for increasing and improving the product, as well as to take advantage of every favorable natural condition.

Many localities are especially favored with an abundance of sunshine at all seasons of the year, and at the same time their climate, due to the influence of large streams or near-by bodies of water, is mild and free from extremes of temperature. In such localities it would be possible to grow lettuce, radishes, and similar crops during the entire winter without protection were it not for a few cold days and nights. A very slight covering or the application of a small amount of heat will, as a rule, carry the plants through in good condition.

During recent years the growing of winter vegetables in frames having removable covers of sash or cloth has developed greatly in the South Atlantic Coast States and in other States having mild winter conditions. In a true sense this industry is simply field culture with provision for covering the crops during temporary periods of cold weather. The present magnitude of this line of work attests its success and indicates its future possibilities. North Carolina undoubtedly has a larger acreage devoted to frame culture than any other State, but in the region about Norfolk, Va., there is also a large and growing area devoted to the work. Vegetables grown in frames are often shipped in carload lots from these large producing sections. This industry may readily be combined with regular truck farming, as it furnishes remunerative employment during the winter months. A comparatively small area is necessary for the frames, but several times that acreage of land should be available, so that the site of the frames may be changed every few years to safeguard against diseases and insect injuries.

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**TYPES OF FRAMES AND THEIR CONSTRUCTION.****CLOTH-COVERED FRAMES.**

The type of frame or bed varies with the different localities and is ordinarily no more elaborate or expensive than is necessary to protect the crops. In North Carolina and South Carolina the type of frame generally used is that shown in figure 1, having for the sides two lines of 12-inch boards set on edge and held in place by means of stakes driven into the ground. The covering of cheap unbleached muslin is supported on strips of wood 1 inch thick and 2½ or 3 inches wide, which are raised in the center by being carried over the top of a stake; the ends are held down by nailing to the sides of the bed.



FIG. 1.—Rows of frames, showing the type used for lettuce growing in North Carolina and South Carolina. The overhead pipes are used for irrigation.

The lumber for the sides is usually 1 by 12 inches by 16 feet of the cheaper grades of cypress or a good grade of common shortleaf pine. The stakes for holding the boards in place are 1 by 3 or 2 by 3 inches in size and are driven about 1 foot into the ground. These cloth-covered beds are usually 14 feet in width, but some growers prefer them 10, 12, or 20 feet wide. The length of the frames varies greatly, but the longer ones generally run from 90 to 100 yards, depending entirely upon the space available and the evenness of the ground. The frames usually run east and west, with the cloth fastened to the north edge of the frame. Most of these frames are temporary and are taken apart and stored during the summer months.

Before placing the frames in position in the autumn the soil is plowed, thoroughly fitted, and given a liberal dressing of well-rotted stable manure and commercial fertilizers. The placing of the boards

will cause some trampling of the bed, and before putting in the ends and nailing on the rafters or strips to support the cloth it is desirable to loosen the soil again by means of a harrow or cultivator. The stakes for supporting the cross strips or rafters are then driven through the center and the strips nailed in place at intervals of 4 feet. The ends are inclosed by means of 12-inch boards, and the bed is then ready for the cloth cover. The cloth is stitched, with the strips running lengthwise of the bed, into one great sheet large enough to cover the entire bed. This sheet is fastened on the north side of the frame by nailing over it plastering laths or similar strips of wood. The cloth should not be fastened to the top edge of the board but on the side, 1 or 2 inches below the top. For fastening the sheet on the south side of the frame short loops of string or cloth are attached to its edge and these are looped over nails driven into the side of the bed. In some cases brass eyelets, such as are used in tent flaps, are inserted in the edge of the cloth and hitched over nails or pins. Another method is to hem the cloth on one edge and run a  $\frac{3}{4}$ -inch rope through the hem. The addition of the rope makes it comparatively easy to fasten the cloth to the side of the bed and also prevents tearing the sheet in handling. The cost of these frames, including lumber and muslin, together with the necessary facilities for supporting and fastening the cloth, will be from 35 to 50 cents a running foot for a bed 14 feet wide.

If it is necessary to refit the land while the frames are in place, the cloth is turned back into the alleys between the frames, the strips that support the cloth are removed, and a 1-horse plow is taken into the inclosure. After the land is plowed and thoroughly firmed, the strips are again put in place. As the work of cultivating the crops must all be done by hand it is essential that the soil be well prepared before planting.

#### SASH-COVERED FRAMES.

In the tidewater region of Virginia the frames are covered with hotbed sash. The climate of Norfolk is a little too severe for the use of cloth except for early autumn and spring crops. A number of growers in the vicinity of Norfolk handle sash-covered frames occupying as much as 3, 4, or 5 acres each season. (Fig. 2.) For the sides and ends of these frames the same class of cheap lumber as for the cloth-covered frames is used. The back or north side of the frame is usually 12 or 14 inches high, while the front or south side is about 4 inches lower to give the sash sufficient slope. The standard hotbed sash universally used for covering these frames is 3 feet in width and 6 feet in length. The usual width of the sash-covered frame is 6 feet, but a double row of sash with a ridge through the center is sometimes employed, making the bed about 12 feet wide.

This arrangement, however, does not prove as satisfactory as the common 6-foot frame. These sash-covered frames are often 300 to 500 feet in length, but the usual length is 180 feet. No strips are provided for the support or separation of the sash, as they rest on the sides of the bed and fit close together.

Two or three types of sash may be used for this purpose, but the lower-priced ones are most commonly employed. One kind of sash is so arranged that the glass may be slid into grooves, the glass abutting without the use of putty. The better grades of sash have provision for bedding the glass in putty, lapping the lights one-eighth to one-fourth of an inch and fastening them in place with glazing



FIG. 2.—Rows of sash-covered frames.

points or specially designed double-pointed tacks. As a rule a very cheap grade of single-strength window glass of the smaller sizes, 6 by 8 and 8 by 10 inches, is employed. It would undoubtedly prove economical in the long run to use double-strength glass of 8 by 10 or 10 by 12 inch sizes. The double-strength glass is not so easily broken in handling or by hail, and makes a heavier and more rigid sash, especially when bedded in putty. In many cases the sash do not cost more than \$1.45 each, fully glazed, while a much better grade could be had for \$1.60 to \$2, including painting. Many of the sash are never painted, and as they are of poor material their period of usefulness is quite short, often not more than four or five years. A well-painted cypress sash, glazed with double-strength glass bedded in putty, should with proper care give 12 or 15 years of service. From

the grower's point of view the object is generally to secure the greatest possible number of sash with the least expenditure, and as a consequence it is the cheaper grades of both sash and glass that are used.

A common practice among gardeners is to construct a shallow tank of cement, planks, or galvanized iron and to dip the sash in crude oil instead of painting them. The oil acts as a splendid preservative for the wood, but the sash so treated are dull in appearance and undoubtedly do not give as much light in the beds as those that are painted white. Most of the sash used for this purpose have six lines of glass with five sash bars. By using three lines of 10-inch glass, only two sash bars are necessary and the shading of the bed will be much less. Actual test has shown a great difference of plant growth in favor of the larger sizes of glass.

### HEATED FRAMES.

Farther north, near several of the large cities, including Baltimore, Philadelphia, Cincinnati, New York, and Boston, sash-covered frames are extensively used for growing early vegetables. This work is practically the same as that found at Norfolk, except that the frames are constructed over an excavation which is filled with fermenting manure to provide heat.

Where manure-heated beds are extensively used for growing early vegetables a long, shallow pit is opened, the manure is trodden in, and 12-inch boards are fastened to stakes to form the sides. The board on the north side is raised a little higher than the one on the south side in order to form a slope for the glass. A few strips are nailed across the bed to prevent the sides from coming in by the pressure of the manure or soil that is banked on the outside, and the sash simply rest on the sides without any guide or supporting strips between them. Straw mats and board shutters are employed as a protection for the sash during cold weather.

A few of the growers around Newbern and Wilmington, N. C., provide steam boilers and install heating pipes in the frames, the heat being applied only during cold weather, when the cloth alone would not prevent injury from frost. Many of the growers have steam outfits for pumping water and simply connect the pumping boiler to lines of pipes which are fastened on the sides of the frames just below the covering. As a rule, the supply pipe is run on the north side of the frame, while the return is placed on the south side, or both flow and return may be on the north or cold side of the bed. (Fig. 3.) Another method of heating consists of laying lines of 3-inch drain tiles 6 or 8 inches below the surface of the soil so as to discharge live steam into the tiles during cold weather. These systems have proved quite satisfactory in a few places, but have not been generally adopted.

## SOIL AND FERTILIZERS.

### PREPARATION OF THE SOIL.

The greater portion of the work with frames is conducted on light or sandy loam soils which are naturally well drained and adapted to intensive trucking. The original soil is usually employed, but when necessary rich soil is hauled and placed in the beds. The first essential is good drainage, and if the land is not naturally well drained it should be tilled or provided with numerous open ditches to carry off the water. The surface of the soil should be graded and all depressions filled in and leveled. For best results the land should be subjected to two or three years of preparation by manuring and planting to leguminous crops.

The presence of plenty of organic matter in the soil is very important, especially where large quantities of commercial fertilizers are to be used. This organic matter may be added in the form of stable manure, but more satisfactory results will be obtained where legumi-

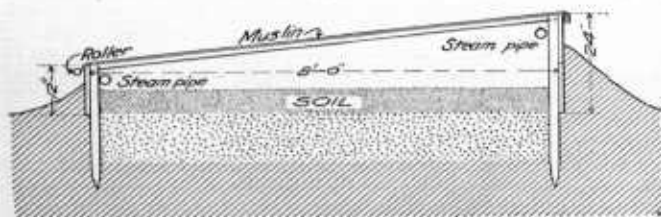


FIG. 3.—Cross section of a pipe-heated bed.

nous crops are included in the preparatory treatment. For green manure nothing is better than cowpeas as a summer crop and crimson clover as a winter crop. The crimson clover should be turned under about the time it comes into full bloom in the spring, the land planted to cowpeas, and the resulting crop plowed under or mowed for hay during the month of August in ample time to prepare the land for frame work during the autumn. When heavy crops of green manure are turned under it is essential that lime be used to improve the mechanical condition and to sweeten the soil; a dressing of 1,000 pounds to the acre should be sufficient.

Wood ashes constitute an excellent source of both potash and lime, especially if they have resulted from the burning of hardwood. Ashes from pine and other soft woods are of little value. Much of the value of wood ashes may be lost by leaching, and while a ton of strictly fresh hardwood ashes would be sufficient to apply on an acre, as much as 5 tons of leached ashes could be used on the same area without fear of burning the plants. Where ashes are used less lime is needed, although the percentage of lime in the ash is comparatively small.

### STABLE MANURE.

Large quantities of stable manure are used in growing crops in frames, sometimes as much as 30 to 60 cartloads to the acre. The manure is generally spread in a broad, flat pile to compost before it is applied to the soil on which frames are to be located. Where manure is employed for heating the beds it may afterwards be mixed with the soil for the growing of subsequent crops. In the work with frames around Norfolk, Va., the manure is placed in long, narrow piles and turned two or three times before it is used in the beds. Care should be exercised to avoid the use of manure in which there are shavings or sawdust, as these have an injurious effect upon the growth of plants. Poultry and sheep manure are excellent fertilizers for frame work, but the quantity obtainable is very small. In the application of natural manures of all kinds it is essential that the manure should be fine; that it be what is termed "short" manure.

### COMMERCIAL FERTILIZERS.

It is desirable that only high-grade fertilizers be used in preparing the soil for growing crops in frames. Nitrogen is the essential element in the production of leaf growth, while potash and phosphoric acid are essential to fruit and seed production. The quantities of high-grade fertilizers that may be applied with safety and profit will vary according to the soil, but if a sufficient quantity of manure has been used it should not be necessary to add more than 1,000 to 1,500 pounds of commercial fertilizers to the acre each season.

A fertilizer for crops raised in frames should contain at least 7 per cent of nitrogen, 8 per cent of phosphoric acid, and 6 to 8 per cent of potash. Nitrate of soda can often be applied to advantage in order to hasten or increase the growth of the plants. It should be borne in mind, however, that nitrate of soda is a very concentrated and available form of nitrogen and that it is easy to overdo the matter and injure the plants; 300 pounds to the acre is considered the maximum quantity for a single application. Two or three such applications may be made during the growing season. Highly nitrogenous fertilizers should not be applied early in the winter, as these have a tendency to force the plants into a soft growth which will be easily injured by cold. For this reason nitrate of soda and similar fertilizers may best be applied as a top-dressing when it is desired to force the plants into a quick growth by scattering it between the rows and working it into the soil by means of a hoe or cultivator. Some growers have tried dissolving the nitrate of soda in water, 1 pound of the salt to 10 gallons of water, and watering the plants with this solution once every week or ten days during the height of the growing season.



### WATERING CROPS IN FRAMES.

To insure success in the cultivation of plants in frames it is necessary to provide some means of applying water to the soil. Occasionally the supply of water can be obtained from the system of some city, but more often it must be pumped from a well or stream and stored for use in an elevated tank. The work of pumping the water is usually performed by a gasoline engine. The common round wooden storage tank, raised about 20 feet above ground, is in general use, and the water is delivered from the pump through a pipe, the end of which is carried up and over the top of the tank. A 4-horsepower engine is large enough to operate a pump having a capacity of about 40 gallons of water a minute. Such an equipment is sufficient for most establishments.

The irrigation systems in the Wilmington, N. C., district are often very elaborate. On some of the plantations a sprinkler system is employed, having large mains for conducting the water and a series of overhead pipes for distributing it through a great number of small nozzles. By this method the water can be applied during bright weather and while the cloth is drawn to one side for ventilation. The lines of distributing pipes are so arranged that the nozzles are all in a line, and the pipes can be rotated so as to throw the water in either direction, thus watering two or three beds from one line of pipe. (See fig. 1, p. 6.)

Where the sprinkler system of watering is not employed the work is generally done with 1-inch garden hose attached to pipes laid in the ground just deep enough to be out of the way of plowing and cultivation. At the points where it is necessary to attach the hose a toe is inserted in the pipe and the opening provided with a 1-inch globe or gate valve. These openings should be about 100 feet apart in one direction and in each alternate space between rows of frames in the other direction. The valves are protected by a square box of planks, about 8 by 10 inches in size and extending about 14 inches above ground. The valves should be about even with the surface of the soil; thus, the top portion of the box not only protects the valve from injury but also affords a support for the hose to prevent its bending sharply over the end of the pipe connection and thereby cutting off the flow of water. (Fig. 4.)

Many gardeners prefer to distribute the water by simply pinching the stream with the thumb, while others attach to the end of the hose a rose or sprinkler similar to that on a watering can. Watering is generally done during the late afternoon, but should be completed early enough to permit the foliage to become reasonably dry before closing the frames for the night. If the plants are young and very tender it will be important to avoid too great a degree of moisture.

Serious losses from "damping-off" often result from excessive moisture, especially at night, when evaporation is not so rapid as during the day. Many gardeners make the mistake of watering too often and not doing the work thoroughly. Under ordinary conditions twice a week will be often enough to apply water, and in winter, when evaporation is at its lowest point, once a week will be sufficient. In watering the sash-covered frames it is necessary either to remove the sash or to prop them up high enough to permit working under them.

As a rule the sash are taken off early in the morning of a bright day, the soil is stirred, sometimes a little fertilizer is added, later in the day the bed is watered, and toward night the sash are replaced.

So far as is known, the subirrigation method has not been extensively or successfully applied to the watering of crops grown in frames. In order to make the

subirrigation method successful it would be necessary to have conditions not ordinarily found in sandy loam soils.



FIG. 4.—Box protector, showing valve and hose connection to water main.

## TEMPERATURE, VENTILATION, AND PROTECTION OF FRAMES.

### TEMPERATURE OF FRAMES.

The temperature at which the air of the beds should be carried will depend entirely upon the crop being grown. Thermometers should be placed at intervals in the beds, as it is not safe to judge the temperature by personal sensation. If lettuce, parsley, or radishes are growing in the beds, the temperature should not go above 70° F. before ventilation is given; on the other hand, if the frames are filled with cucumbers, eggplant, or peppers, the temperature may run 8 or 10 degrees higher.

It should be borne in mind that any covering, whether cloth or sash, will exclude a part of the light, and every precaution is necessary to prevent the plants becoming "drawn." The safest plan is to keep the temperature a trifle low and thus retain the plants in a

strong, thrifty condition. Where tender plants are being grown under cloth there is greater danger of injury from keeping them covered too tightly than from exposure to moderate cold.

#### VENTILATION OF FRAMES.

In the care of cloth-covered frames the covers are left off during bright weather and the plants subjected to open-air conditions. When there is danger of cold the covers are put on at night, and during unfavorable weather they are frequently left on during the day. While the cloth covers conserve the heat, they at the same time exclude the sunlight, and if they are kept on too great a portion of the time the crops will become drawn and spindling.



FIG. 5.—Sash-covered frames, showing a fence used to break the force of the wind and notched sticks used under the sash for ventilating the beds.

With sash-covered frames the matter of ventilation is of prime importance. The glass admits and holds the heat of the sun's rays, and during bright weather it is necessary to open the frames quite early in the morning. Ventilation is accomplished by propping up one end or one side of the sash on a notched stick, such as is illustrated in figure 5. Sometimes each alternate sash is lifted at opposite ends, or they may all be lifted at one end. If only a small amount of ventilation is required every other or every third sash is lifted a trifle; later, when more air is needed in the frames, the sash are raised higher and are finally removed altogether. The rule to be followed is to ventilate on the side away from the wind, so that the wind will blow over the opening and not into the bed.

### PROTECTION OF FRAMES.

The area occupied by the frames is often surrounded by a high board fence or a hedge of evergreens to break the force of the wind. If a large area is devoted to frames it is sometimes subdivided by numerous cross fences to break up air currents and lessen the force of storms. The type of fence most commonly used is shown in figure 5.

Where no heat is applied to the frames the control over temperature will not be great except in the prevention of too high temperature by means of ventilation during bright weather. In many instances straw and burlap mats are kept ready at hand for throwing over sash-covered frames to prevent loss from freezing, but this would not be practicable on a large scale. Sometimes the glass is covered by shoveling one-half or three-fourths of an inch of soil over it, but this involves considerable labor and frequently results in the breakage of a great deal of glass. It is possible to ward off frost by the use of a number of orchard heaters in the frame yard. These heaters burn kerosene or crude oil and give off both heat and a smudge which will prevent injury from a reasonable degree of cold. A good type of orchard heater is shown in figure 6.

### CROPS GROWN IN FRAMES.

The crops most commonly grown in frames are lettuce, radishes, cucumbers, garden beets, parsley, eggplant, peppers, and snap beans. The crops grown in the sash-covered frames do not differ materially from those grown under cloth. In the spring, however, the growers around Norfolk devote their beds almost entirely to cucumbers and eggplant instead of to lettuce and radishes. To the southward the cloth covers are sufficient to protect the more hardy crops throughout the winter. To the northward the hardy crops may be grown under sash in midwinter, and those requiring more heat are grown in the spring.

Descriptions of the methods used in handling the several crops grown in frames follow.

#### LETTUCE.

Lettuce may be considered as first in importance among the crops grown in frames. The more hardy types of head lettuce, such as Big Boston, are grown. A variety suited to frame work must be

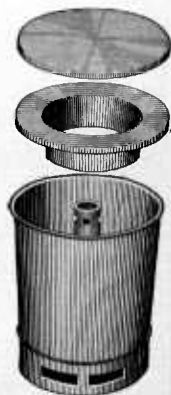


FIG. 6.—An oil heater holding 7 quarts of oil.

capable of withstanding considerable cold and exposure and at the same time produce a head that will find ready sale upon the market. Two crops of lettuce are usually grown, an autumn or early-winter crop and a late-winter or spring crop. The seed for the autumn crop is sown from August 15 to September 10, the plants being set in the beds from September 15 to October 15. As a rule, the plants are set about 8 by 10 inches apart in the beds. The autumn crop will be ready for market from November 20 to January 1. Seed for the spring crop is sown during October in the open ground or in beds and set in the frames as fast as the first crop is removed. The second crop will be ready for market from March



FIG. 7.—Lettuce growing in frames. The sash are piled between the beds ready for use in case of a cold snap.

1 until superseded by the outdoor lettuce. (Fig. 7.) In order to secure stocky plants the seed bed should not be so rich as the soil where the crop is to be grown.

As very little cultivation can be given the lettuce crop in the beds, it is essential that the soil should be well prepared and very rich. Plenty of organic matter is required, and this is best obtained by applications of well-rotted manure.

Lettuce does best under comparatively cool conditions, and plenty of ventilation is necessary. Heavy losses have resulted from the careless methods followed by many of the growers of lettuce in frames, especially as regards ventilation and watering.

### RADISHES.

Radishes are frequently grown as a catch crop between the autumn and spring crops of lettuce, or as a filler between hills of cucumbers or between the plants of eggplant or peppers. The varieties most commonly used are Scarlet Globe, French Breakfast, Long Scarlet Short-Top, and Icicle. The radish seed is simply sown in rows and the plants thinned so as not to crowd one another.

### CUCUMBERS.

The cucumber is one of the most important of the crops grown in frames, especially around Norfolk. The cucumber crop is handled



FIG. 8.—Cucumber vines growing in frames, about the time they begin to spread over the ground.

in the following manner: About the first of February, while most of the beds are occupied by lettuce and radishes, the cucumber plants are started in a hotbed in 1-quart berry boxes.

By some growers special 3-pint boxes, similar to the berry boxes, are used for this purpose. The boxes are filled with rich soil that has been thoroughly mixed and sifted, and 7 to 10 seeds are sown in each box. The boxes are then set directly in a manure hotbed and are kept watered until the seed germinates. When the plants appear they are thinned to about three in a box.

From the start great care is taken to give the plants sufficient ventilation to prevent their becoming spindling. If the plants should

grow a little too tall it is customary to fill up the boxes with sifted soil to secure stocky, well-rooted plants for setting in the frames. By the time the cucumbers are ready for the frames and the lettuce and radishes have been marketed, the sash are removed from the 6-foot frames, and a deep double furrow is opened through the center of the bed by means of a one-horse plow.

While the plants are being grown in the hotbed the manure which is to be used in the frames has been composted. This is hauled and spread in the furrow, and the soil is returned to its former position by means of the plow. In planting, the boxes containing the hills of plants are lifted from the hotbed, placed in a wheelbarrow or in trays, and carried to the frames, where a small hole is dug, the main portion of the box removed by slitting with a knife, and the hill of

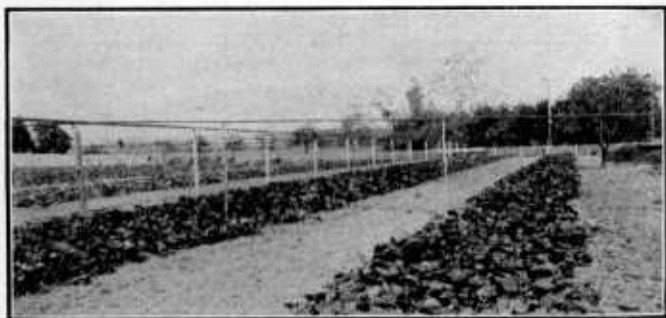


FIG. 8.—Cucumber vines after the removal of sash and frames.

cucumbers set in place and thoroughly watered. One hill is placed directly under the center of each sash.

In addition to the manure that is applied to the land before planting to cucumbers, frequent top dressings of chemical fertilizers are given. First, when the plants are just beginning to form vines a handful of fertilizer is scattered around each hill; none of this, however, is placed nearer than 6 or 8 inches from the hill. At the same time the soil is given a hoeing, and later in the day is watered. In about three weeks, when the vines are 18 inches or 2 feet long, the soil is given another dressing with fertilizer, this time making the application at a greater distance from the hills. The fertilizer generally used for this purpose contains about 7 per cent of nitrogen, 6 per cent of phosphoric acid, and 6 per cent of potash. The appearance of the cucumber vines at this stage is shown in figure 8.

About the time that the cucumber vines fill the entire space within the frame the weather will have become warm enough to leave the sash off, at first during the day and then during both the day and the night. A little later the sash are removed and piled at the ends of the frames, so that they may be quickly used to protect the beds in case of a late frost. After all danger of frost is past the sash are hauled and placed in the storeroom for the summer, and the boards forming the sides of the frames are removed and carefully piled in some convenient place where they will be protected. The cucumber vines are then turned up, first on one side and then on the other, a third top-dressing of commercial fertilizer is given, and the space between the rows formed by the removal of the frames is thoroughly cultivated. After cultivation the vines are again turned into place and allowed to occupy the entire space, as shown in figure 9. The beds are 6 feet in width and are generally placed 6 feet apart, forming a 12-foot space between the cucumber rows.

As a rule considerable fruit is gathered before the removal of the frames, but the largest pickings generally occur about two weeks later. If spraying is properly attended to, the cucumbers continue to produce until the field crop of the same locality is ready for shipment in large quantities. After the crop is no longer profitable the area should be cleared of all refuse and put in shape for the next year's operations. A crop of cowpeas may very conveniently be grown upon the land during the summer and used for hay or turned under.

#### PARSLEY.

Parsley is sometimes grown as an all-year crop, or it is grown during the autumn and winter and the land devoted to lettuce or cucumbers during the spring. The parsley seed is sown in August or September and the seedlings transplanted to the frames as soon as they are large enough to be handled. Cutting of the leaves begins in the autumn and continues throughout the winter, and often until quite late in the spring provided prices remain good. Parsley is not easily injured by cold, and it is customary to remove the sash and frames early in the spring and take them to some other location where they may be used for the growing of cucumbers, eggplant, or some other less hardy crop. Figure 10 shows parsley growing in frames from which the sash have been removed. Parsley is one of the easiest of crops to be grown in frames, and if a good market can be found it may prove very profitable.

#### EGGPLANT.

The seeds of the eggplants are started in heated beds or sometimes in small greenhouses. When the plants are large enough to handle



they are transplanted from the seed bed to small pots, from which they are later shifted to 5-inch or 6-inch pots or to large berry boxes. Eggplants require plenty of heat and it is not safe to set them in the frames until the weather is quite warm, or about March 15 or 20 in the Norfolk region. As a rule the eggplants are set 18 or 20 inches apart each way in the beds among the lettuce. By the time the lettuce is removed the eggplants will be almost ready to begin fruiting. The sash are then removed and the eggplants given a top-dressing of fertilizer and cultivated.

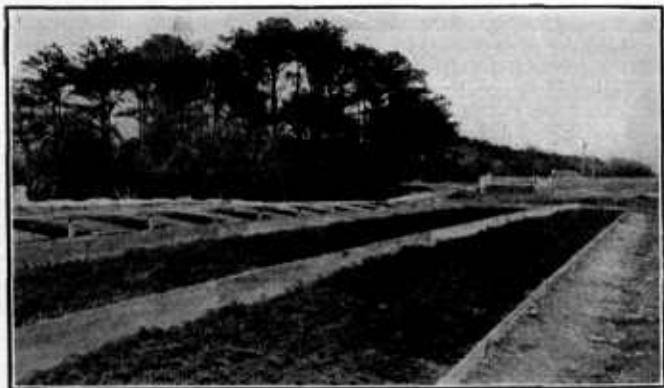


FIG. 10 — Parsley growing in frames.

#### PEPPERS.

The large, sweet peppers are sometimes grown in frames, the crop being handled in practically the same manner as eggplant. It is doubtful whether peppers grown in frames will ever give returns equal to those from eggplant and cucumbers.

#### GARDEN BEETS.

Two methods of growing beets in frames are practiced. By one method the plants are started in a special seed bed, and when of sufficient size they are transplanted to the cloth or sash covered frames, where they grow to a marketable size. By the other method the plants are simply started in the frames and then transplanted to the open ground to mature. Where the crop is grown under sash it is customary to remove the sash and frames after the beets have

attained considerable growth (fig. 11), the frames and sash being used during the remainder of the season for cucumbers. The beets are marketed when about 2½ inches in diameter. The variety known as Early Egyptian is most commonly planted, although Crosby's Egyptian is sometimes used.



FIG. 11.—Beets growing in beds after the removal of frames.

#### SNAP BEANS.

A crop of snap beans is frequently grown by planting them in the beds beside every third row of spring-crop lettuce; then, after all danger of frost is past, the cloth is taken off and the entire frame removed, leaving the beans to grow as a field crop. The wax-podded varieties of beans are generally employed for this purpose.

At the North, after the spring lettuce crop has been removed, the frames are sometimes filled with early tomatoes (trained to stakes), early celery, or early plants for setting in the general garden.

#### PREVENTION AND CONTROL OF DISEASES AND INSECTS.

##### DISEASES.

The principal drawback to the growing of truck crops in frames, especially lettuce and cucumbers, is the danger of loss from diseases. Lettuce growers in the South Atlantic States have suffered heavy losses from the disease known as "drop." This is caused by a fungus (*Sclerotinia libertiana*) which attacks the plants as they approach

maturity, causing them to wilt and afterwards decay. Preventive measures for this disease have been found by the North Carolina Agricultural Experiment Station to be based on three main principles:

(1) That the fungus is incapable of infecting healthy plants unless it finds bits of dead leaves on which it can establish a foothold; (2) that it forms no spores, but reproduces itself through hard, black masses, which are formed only in the later stages of decay; and (3) that the spread of the disease in frames is favored by heavy watering and lack of ventilation. The lettuce grower should therefore exercise great care to keep all dead leaves picked from his plants and to remove and burn any plants which contract the disease at the first indications of wilt before the black masses are formed. Watering should be done only on bright days when it is possible to have the plants become fairly well dried off before the bed is closed for the night. When a piece of land becomes heavily infected with this disease the best policy is to move the frames to fresh soil, first disinfecting the woodwork with a 1 per cent solution of formaldehyde or a 0.5 per cent copper-sulphate solution.

If it is not possible to change the location of lettuce beds which are badly infected with "drop," and facilities are available, steam disinfection of the soil, which has proved an effective means of preventing the disease, may be used. The soil may be disinfected or sterilized by blowing live steam through drain tiles laid in the bottom of the beds or by means of an inverted pan under which steam is forced.

In the tile method of steaming, lines of 2-inch to 3-inch drain tiles are placed lengthwise in the beds, 2 to 2½ feet apart and 12 to 15 inches below the surface, and left there permanently. The tiles provide drainage for the beds, may be used for subirrigation, and are available at any time for disinfecting the soil, the only outlay of labor being the covering of the beds with boards, a tarpaulin, or a layer of straw, and the connecting of the tile with a boiler by means of a piece of steam hose. The soil need only be spaded or plowed deeply to loosen it.

The inverted-pan method of steaming involves the use of a galvanized-iron pan, 6 by 10 feet and 6 inches deep, which is inverted over the soil to be disinfected, the edges forced down into it, and steam admitted through a steam hose under pressure. The use of steam at a pressure of 80 to 100 pounds in the boiler and treatment for half an hour to an hour after the soil has reached the boiling point, as indicated by soil thermometers, has given the best results.

Cucumbers grown in frames are subject to downy mildew and anthracnose like those grown outside. These diseases may be effectively prevented by spraying with Bordeaux mixture. The formula usually recommended is 3 pounds of copper sulphate, 6 pounds of lime,

and 50 gallons of water.<sup>1</sup> Nothing weaker than this should be used, while the 5-5-50 formula is preferred by some. It is essential that every part of the plant be thoroughly covered with a fine spray. Spraying should begin before the plants leave the hotbed and continue at intervals of ten days or two weeks. Toward the end of the season, if the diseases are prevalent in the neighborhood, the spraying should be done every four or five days.

### INSECTS.

The injuries to frame crops due to the ravages of insects are of minor importance as compared to those of diseases; however, it is necessary to keep the insects under control or great damage may result. Aphids are quite troublesome, and cutworms occasionally play havoc, especially with young plants.

The aphids may generally be controlled by the liberal use of tobacco stems and dust sprinkled in the frames. Sometimes the beds are fumigated with tobacco stems or with aphis punk, which is burned in the tightly closed frames. Care must be exercised, however, to see that the application is not made too strong, or injury to the foliage may result.

Spraying with kerosene emulsion and soap preparations is effective in combating aphids, but such sprays are often objectionable for use on salad crops. The cucumber growers around Norfolk have found that if the tobacco stems are allowed to remain indefinitely on the beds they have an injurious effect upon the plants. Three or four days after the stems are applied they should be removed; then if the aphids are still present an application of fresh stems may be made.

Where cutworms are injuring lettuce and similar crops it is customary to put in baits of wheat bran or fresh clover leaves which have been poisoned by treatment with Paris green or arsonate of lead. For their protection when set out, the plants should be dipped or sprayed with a solution consisting of 1 pound of arsenate of lead to 25 gallons of water. Hand picking may prove effective whenever the insects are too numerous.<sup>2</sup>

### MARKETING CROPS GROWN IN FRAMES.

Crops grown in frames are usually superior in quality and appearance to those grown in the open and should be given more care in handling and marketing. The cost of production is somewhat higher than for outdoor crops, and it is essential that they be put up in neat

<sup>1</sup> See "Spraying for Cucumber and Melon Diseases," *Farmers' Bulletin* 231, U. S. Dept. of Agriculture.

<sup>2</sup> For further information on the control of aphids, the reader is referred to Circular 80, Bureau of Entomology, U. S. Dept. of Agriculture.

packages in order to bring the highest market price. The mere successful growers give the work of gathering, grading, and packing the crop their closest personal attention and use only clean, attractive packages for handling and shipping.

The packages employed for handling the frame products are generally the same as those used for marketing outdoor vegetables of the same kinds. In a few instances a distinctive package has been employed. The use of special shipping packages that would give the frame-grown produce special recognition on the markets would be a decided advantage to the grower.



FIG. 12.—Barrels of parsley, showing the method of packing with a block of ice in the center of each barrel.

Lettuce is usually shipped in the tapering half-barrel hamper basket with a wooden cover, or sometimes in crates or bushel baskets. The lettuce is not washed, but is packed in the baskets as it is cut from the beds and hauled direct to the shipping point, where it is loaded into refrigerator cars or sent forward by express. All of the lettuce in a bed will not be ready for cutting at one time, and it is necessary to cut over the beds three or four times.

Cucumbers are generally picked early in the morning, before the heat of the day, and while they are fresh and crisp. In removing the cucumbers from the vines a sharp knife or pair of shears should be used to cut the stems. The cucumbers are washed by floating them for a minute or two in a tank of clear, cold water and are then placed

upon a rack or screen to drip before packing. Cucumbers are packed in two or three sizes of hampers with wooden covers; also in common, flat, half-bushel, handle baskets, covered with paper. A few growers employ a distinctive crate or box holding about a bushel. As a rule each box is lined with paper, and when filled the top is partly covered with slats, leaving the cucumbers slightly exposed.

Parsley is shipped in 1-bushel crates, half-barrel hampers, and in 4-bushel barrels. Sugar barrels are sometimes used. For some of the markets the parsley must be washed and tied in bunches, while for other markets it is shipped loose. When making shipments in the large barrels it is customary to place a block of ice in the top of each barrel, as shown in figure 12. The barrel is covered with a piece of burlap.

Radishes and beets are tied in bunches and shipped in hamper baskets or sometimes in the veneer barrels so commonly used for handling spinach and kale.

Eggplants are shipped in baskets or in crates like those used for handling strawberries. Each eggplant is usually wrapped separately in thin paper or inclosed in a paper bag.

Peppers are generally wrapped in tissue paper and packed in wooden pans, such as are used for marketing early tomatoes. Four or six of these wooden pans are packed in a carrier for shipment.

The snap beans that are grown in frames are shipped in the regular five-eighths bushel and half-barrel hamper baskets, such as are used for handling the general field crop.

### SUMMARY.

In certain localities where the climate is mild, such crops as lettuce, radishes, and beets can be grown during the winter months if provision is made for protecting the plants during the few periods of freezing weather. The cheapest form of covering is cotton cloth or unbleached muslin.

In other localities, where the climate is too severe for growing crops under cloth protection, cheap sash filled with glass are effective. A good living can be made on 3 acres devoted to sash gardening.

Cheap hotbeds, constructed in long lines with plank sides, may be profitably employed for forcing vegetables for the market in the neighborhood of large cities, where an abundance of manure for heating material may be obtained.

The labor and expense involved in the growing of vegetables in frames are greater than for a corresponding area in the open; therefore greater care should be taken in gathering, packing, and marketing them in order that fancy prices may be obtained.